Risk Adjusted Performance Measures

Asset Allocation / Risk Management

September 11, 2006



Topics

- Define Performance Measures
- Example Calculations
- Summary



• Question:

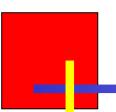
– How do we know if we are generating adequate returns for risk taken?

• Answer:

 Use risk adjusted performance measures to relate returns and risk.

• Simply stated:

– How much risk was taken to generate a given level of returns?



Risk Adjusted Performance Measures

We can use these measures:

- Sharpe Ratio
- Sortino Ratio
- Treynor Ratio
- Information Ratio

- Value at Risk (VaR)
- Performance at Risk (PAR)

Sharpe Ratio

$$\frac{Rp - Rf}{\sigma p}$$

Measures portfolio excess return relative to total portfolio risk

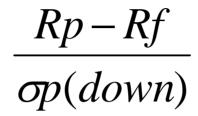
- Hedge Fund Partners0.48
- CalPERS Hedge Fund-UBS 1.32

 $R_p = Portfolio Return$

 $R_f = Risk Free Rate$

 σ_p = Standard Deviation of Portfolio Return





Measures portfolio excess return relative to total portfolio risk (negative returns only)

- Hedge Fund Partners0.77
- CalPERS Hedge Fund-UBS 2.34

 $R_p = Portfolio Return$

 $R_f = Risk Free Rate$

 σ_p = Standard Deviation of Portfolio Negative Return

Treynor Ratio

$$\frac{Rp - Rf}{\beta p}$$

Measures portfolio excess return relative to portfolio beta (common factor) risk only

- Arrowstreet Capital 17.8
- Baillie Gifford Overseas Ltd. 25.0

 $R_p = Portfolio Return$

 $R_f = Risk Free Rate$

 B_p = Beta of the Portfolio



$$\frac{Rp-Rb}{\sigma(Rp-Rb)}$$

Measures portfolio active return relative to portfolio active risk (relative to benchmark)

- Enhanced Index 1.57
- Quantitative Management Associates 0.42

 $R_p = Portfolio Return$

 $R_b = Benchmark Return$

 $\sigma(R_p - R_b)$ = Standard Deviation of Portfolio Active Return

Value at Risk \$ (VaR)

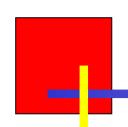
$$\sigma(Rp)*1.645*Vp$$

Measures how much the market value of a portfolio might decrease over a certain time period and at a certain confidence level e.g. "bad case loss"

V_p = Portfolio Value (\$)

1.645 = Z-Scale factor for 95% confidence level (assuming returns are normally distributed)

 $\sigma(R_p)$ = Standard Deviation of Portfolio Return



Value at Risk (VaR)

			Value at Risk (VaR) 1 in 20 Year Loss	
	Market Value \$ Billions	Total Risk	VaR \$	VaR %
Total Fund	\$208	8.4%	\$29	13.8%
PERS 2500 Index Fund	\$55	12.3%	\$11	20.2%
Internal International Equity Index	\$14	14.6%	\$3	24.0%

Performance at Risk (PAR)

$$\sigma(Rp-Rb)*1.645*(Vp/Vf)$$

Divides VaR\$ by Total Fund Value to determine "bad case loss" as % of Total Fund Value

- PERS 2500 Index Fund
 7 bp or \$14 billion
- Internal International Equity Index 1 bp or \$2 billion

 $V_p = Portfolio Value (\$)$

 $V_f = Total Fund Value (\$)$

1.645 = Z-Scale factor for 95% confidence level (assuming returns are normally distributed)

 $\sigma(R_p - R_b)$ = Standard Deviation of Portfolio Active Return

Example

Assumptions

$$R_p = 10\%$$
 $R_f = 4\%$
 $R_b = 9.8\%$
 $\sigma_p = 12\%$
 $\sigma_{p (down)} = 14\%$
 $\beta = 1$
 $R_p - R_b = .20\%$
 $\sigma (R_p - R_b) = .40\%$
 $V_p = $1 billion$
 $V_f = $200 billion$

Example

Measure	Calculation	Answer
Sharpe Ratio	(10% - 4%) / 12%	.50
Sortino Ratio	(10% - 4%) / 14%	.43
Treynor Ratio	(10% - 4%) / 1.0	.06
Information Ratio	(10% - 9.8%) / .40%	.50
Value at Risk (Active Risk \$)	.40% * 1.645 * \$1 billion	\$7 million
Value at Risk (Total Risk \$)	12% * 1.645 * \$1 billion	\$197 million
Performance at Risk (Active Risk %)	.40% * 1.645 * \$1 billion / \$200 billion	.0035%
Performance at Risk (Total Risk %)	12% * 1.645 * \$1 billion / \$200 billion	.0985%



Benchmark Independent Measures of Return and Risk		
Example Application: Absolute Return Strategies		
Sharpe Ratio	Based on total risk – common factor & security specific	
Sortino Ratio	Based on total risk – left tail only (non-symmetric)	
Treynor Ratio	Based on total risk – common factor only	
Relative (Benchmark Based) Measures of Return and Risk		
Information Ratio	Based on active risk	
	Relevant for active strategies measured against benchmark	
Measures of How Much We Can Lose		
Value at Risk	Based on either active or total risk	
Performance at Risk	Based on either active or total risk as % of Total Fund \$	